ties of superior quality. The chief vegetable productions indigenous to the soil and growing wild in the forests are india-rubber and gutta-percha, baroos camphor and gum damar, and many valuable kinds of hard-wood timber. Rice, millet, tapioca, Indian corn, sugar-cane, tobacco, cotton, pepper, and many kinds of tropical vegetables are cultivated by the natives. The sago palm is found in abundance, cassia lignea is met with in some localities, and cocoa-nuts, the areca palm, mangoes, limes, oranges, bananas, and pine-apples are plentiful. Under the head of animal productions the report mentions edible birds'-nests, beeswax, hides and horns of cattle and deer, mother-o'-pearl shell, seed pearls, bêche de mer or trepang, and tortoise-shell; elephants exist in the Kinabatangan province in large numbers; rhinoceros, numerous deer of large and small breeds, and wild pigs are met with in many parts, but beasts of prey of the feline species appear only to be represented by a small cheetah in the interior. Minerals will, doubtless, be found in abundance in Northern Borneo. Gold occurs in several localities. Borneo diamonds are famous for their purity and water, and it is believed that they exist in Sabah as well as in Dutch territory. Tin, antimony, coal, quicksilver, iron, copper, petroleum, and other valuable minerals and metals, there is reason to believe, will be found in the territory of the association, but there has not yet been time for even a partial exploration of it from a geological and mineralogical point of view. The labour question may cause some little trouble. The population near the coast consists of Malays, Lianuns, Bajous, Sulus, and others of a mixed breed who are lazy, indolent, and averse to manual labour of any kind. The aborigines in the interior, Dusuns and Ida'an, are peaceful and docile, and accustomed to a certain kind of labour. But the company will not have to rely upon either for the development of their territory, for, as the report puts it, "the enormous amount of labour waiting for employment in the Chinese Empire, not more than three or four days' distance by steam from North Borneo, is at the disposal of intending planters and others . . . on reasonable terms."

VULCANOLOGY IN ITALY IN 1878[1]

A FEW years ago Cav. Michele Rossi, brother and collaborateur of the well-known author of "Roma Sotterranea," determined to try the experiment of collecting together from all parts of Italy facts connected with Vulcanology, and publishing an account of them in the form of a monthly fasciculus. He hoped by this means to found a new school for the study of endogenous meteorology, to be affiliated with the study of meteorology proper. The experiment has succeeded admirably, and we have before us a volume of 140 pages, recording all the phenomena of internal telluric dynamics which have been observed in Italy and Sicily during the past year. The vulcanology of Sicily, notably of Etna and the eastern sea-board, is also recorded in the Acts of the Accademia Gioenia of Catania. In no other part of Europe, except Iceland, would it be possible to have a journal solely devoted to the volcanic phenomena of one country. The kingdom of Italy contains within it the two most famous volcanoes in the world; it contains solfataras, soffioni, and maccalube; it is subject to earthquakes, sometimes of great severity, and spread over large areas; the district between Naples and Cape Misenum embraces almost every phase of volcanic phenomenon, excepting only the geysirs, and the Stufe di Nerone belong to this class of effects. Hence, obviously, there is no country of equal accessibility in the world which is so well adapted for the study of vulcanology.

The *Bullettino* opens with a tribute to the memory of Padre Angelo Secchi, which is followed by a proposition to erect a monument to his honour. We were glad, a few weeks ago, to notice that a well-executed bust of the great Roman astronomer had already been placed among those of the many celebrities which adorn the Pincian Hill. The new monument will probably take the form of a *monumento meteorologico*, to be erected in Rome.

A list of twenty-six Italian observatories in which seismic observations are recorded is given in the *Bulletino*, with the names of the observers, who are in direct communication with Prof. de Rossi. Among the minor notices we find mention of the proposed railway to the observatory of Vesuvius; of various new seismological observatories, including that of the Solfatara at Puzzuoli; and of the earthquake which was simultaneously felt at Fiumalbo, Florence, and Rocca di Papa. Bibliographical notices and correspondence find a place at the conclusion of the fasciculus. In the next number we find letters on the application of the microphone to seismological studies, from Prof. Michele Rossi and Count Giovanni Mocenigo, and later in the volume a very interesting article by the former details his experiments on the subject. The Umbrian earthquake of September, 1878, receives full description at the hands of Prof. Arpago Ricci; Silvestri gives an account of the mud eruption which broke out on the sides of Etna near Paternò in December; and Palmieri continues his "Cronaca Vesuviana" to the end of September, 1878. An exact account of the time of occurrence of earthquake phenomena in any part of Italy is entered in a tabular form, and it is surprising to notice that not a day passes in Italy without some indication of endogenous dynamic action. This also proves to us the sensibility of the instruments. The date is given, then the hour, the place, and the nature of the observation, thus:—

"13.—0.08 a. Messina, forte.—Reggio di Calabria, due scosse.—Palmi, scosse.—Capo Spartivento, molto forte.—Tropea, leggera ondul.
1.15 a. Corleone, leggera E—O, rombo.
5.50 a. Tolmezzo, debole; altra poco dopo.
7.15 a. Narni, sensibile N O—S E.
Mattina Rocca di Papa, leggerissima.
11.15 a. Bologna, leggerissima."

At the conclusion of the volume there is a large table showing at a glance the daily distribution of earthquakes throughout Italy. Twelve vertical divisions correspond to the twelve months of the year, and these are further divided by small lines into days. The horizontal lines serve to indicate:—

1. In the uppermost portion of the diagram the height of the barometer in millimetres. Thus we have the barometric curve for each month.
2. Here also is shown the variations during each month of the level of the water in the wells of Leghorn and Porretta.
3. Earthquakes according to the latitude.
4. Earthquakes according to the longitude, east and west of the meridian of Rome.
5. Daily maxima of the force of the shocks.
6. Phases of the moon.
7. Daily maxima of the number of the shocks.

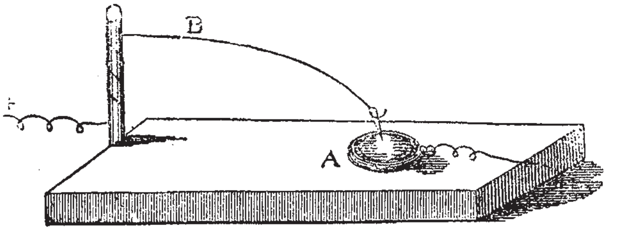
In Prof. Michele Rossi's seismological observatory in Rome we saw at work a set of instruments devised by himself for registering both vertical and horizontal shocks. These are not the same as Palmieri's instruments, and are said to be more sensitive. In both sets of instruments the general principle is the same. The shock, by its movement, communicates motion to some appliance, such as a pendulum, or a column of mercury in a bent tube, which establishes electrical communication with a recording instrument. In the latter a ribbon of paper is drawn at a definite rate over a drum, and whenever electrical contact is established a small electro-magnet becomes active and draws down an armature to which a pen is attached, and for every contact a mark is made upon the

[1] Bulletino del Vulcanismo Italiano. Periodico geologico ed archeologico per l'osservazione e la storia dei fenomeni endogeni nel suolo d'Italia. Redatto dal Cav. Prof. Michele Stefano de Rossi. Roma, 1878.

paper ribbon. The length of paper corresponding to an hour of time being known, it is easy to determine the instant at which the mark has been made, viz., the instant at which the shock has occurred.

Without any doubt the most interesting article in last year's *Bulletino* is that on the application of the microphone to the study of subterraneous meteorology, by Prof. Michele de Rossi. In 1875 Count C. Mocenigo, of Vicenza, made an observation which was nothing less than the fundamental fact of the microphone, at a time when neither microphone, phonograph, nor micro-tasimeter had been invented. He observed that electric currents indicate perturbations and interruptions in a galvanometer by means of frictions and shocks produced artificially between conductors not in perfect contact ("per effetto soltanto di attriti e di scosse communicate artificialmente ai conduttori posti fra loro in semplice contatto instabile"). He also observed that the same phenomena were produced by natural and unknown causes, when the apparatus had not received any artificial shock.[1] The account which he gave of his observations led Prof. de Rossi to conclude that these unknown perturbations arose from microseismic oscillations of the soil. He communicated his views to Count Mocenigo, who at once commenced to make experiments in the direction indicated, in the midst of which the news of the invention of the microphone in America, was received. Prof. de Rossi at once endeavoured to apply it to the detection of subterranean phenomena, and for this purpose he commenced a series of experiments in the seismic observatory which he has established at Rocca di Papa, one of the Alban Hills about seventeen miles from Rome. A special microphone consisting of a balanced pointed lever lightly touching a plate of silver, was mounted on a stone pedestal, and was placed twenty metres underground, at a distance from habitations and from roads. It was also thoroughly isolated and shut up in a box filled with wool. The instrument was watched during some of the stillest hours of the night, and the same mysterious sounds which Count Mocenigo had recognised were heard by de Rossi, which he considers were incontestably natural and intra-telluric. The sounds were carefully analysed, and were compared with artificially produced sounds. The microseismic sounds were speedily differentiated from other sounds, and their nature was completely confirmed when it was observed that they were often coincident with movements of the seismograph, and that they were of a periodic character. On one occasion, as de Rossi was listening at about half-past three o'clock in the morning the telephone connected with his subterranean microphone emitted sounds like the discharge of musketry, of such loudness that he feared they would awaken a child who slept in the same room, and he therefore disconnected the telephone. A short time afterwards, towards four o'clock, a sensible shock of earthquake occurred, for which the sounds had been the microphonic preparation.

In the beginning of last September Vesuvius showed many signs of an approaching eruption. During the night of the 22nd of that month the mountain produced thundering sounds, and at the same time loud metallic noises were heard in the microphone, more than a hundred miles distant. The microphone was soon afterwards transported to the observatory on Vesuvius, and it was then possible to trace the precise correspondence between the movements of the seismographs and the sounds of the microphone, and moreover to ascertain the seismic value (*il significato sismico*) of the different sounds of the microphone. It was also ascertained that if a watch were connected with the microphone, the noise of the tic-tac heard in the telephone became much louder just before a shock, and gradually less and less loud as the seismic agitation died away. This led Prof. de Rossi to improvise a microphone which he has found very useful for microseismic purposes.



A watch, A, is placed upon a suitable stand, and a thin copper wire, B, connected with the positive pole of a small battery is arranged, as shown in the figure, so that one end of it, furnished with a steel needle, rests lightly upon the smooth silver surface of the watch. The handle of the watch is connected by the wire with the telephone, the other binding screw of which is connected with the negative pole of the battery. Such an arrangement furnishes a very effective microphone, if the degree of contact between the needle and the surface of the watch be carefully regulated.

G. F. RODWELL

[1] "Fenomeni singolari di interferenza fra le correnti elettriche ed i promossi mecanicamente sul legno."—Bassano, 1875.

OUR ASTRONOMICAL COLUMN

THE OCCULTATION OF ANTARES, JULY 28.—The only occultation of a very conspicuous star during the present year which is visible in this country and in fact the only one higher than the second magnitude up to the year 1883, is that of Antares on the evening of July 28. It will take place at a low altitude here. As is well known Antares is a double star, and the effect of the duplicity was shown by observation of the occultation of the star by the moon, before the companion was detected by Mitchel at Cincinnati in July, 1845. The appearance of a comparatively faint star at emersion, suddenly brightening up to the full brilliancy of Antares, had been recorded, and a suspicion of duplicity entertained at least in one instance, some twenty years previous. Interest therefore attaches to the occultation of July 28, and with the view to facilitate the determination of the times of immersion or emersion at any place in this country, we will apply the Littröw-Woolhouse method of distributing the prediction of the phenomenon. Direct calculations give the following results for Greenwich, Edinburgh, and Dublin; the moon's place is corrected nearly to agree with Newcomb's theory:—

	Greenwich M.T. of Immersion. h. m.	Angle from N. Point. °	Greenwich M.T. of Emersion. h. m.	Angle from N. Point. °
Greenwich.	9 38·11	153·3	10 7·03	200·2
Edinburgh.	9 38·53	166·5	9 49·93	184·9
Dublin ...	9 33·05	161·4	9 50·53	189·0

From which, putting the latitude of the place = 50° + L (L in degrees), and the longitude in minutes of time = M (+ if east, − if west of Greenwich), we find—

$$\text{G.M.T. of Immersion} = 9^{h}\ 36^{m}{\cdot}86 + 0{\cdot}841\,L + 0{\cdot}263\,M$$

$$\text{,, Emersion} = 10\ 10{\cdot}74 - 2{\cdot}507\,L + 0{\cdot}462\,M$$

$$\text{Angle from N. Point at Immersion} = 149^{\circ}{\cdot}4 + 2{\cdot}6\,L - 0{\cdot}1\,M$$

$$\text{,, ,, Emersion} = 204{\cdot}2 - 2{\cdot}7\,L + 0{\cdot}2\,M$$

These formulæ give for—

	Immersion. h. m.	Angle. °	*Emersion.* h. m.	Angle. °
Cambridge ...	9 38·7	155	10 5·2	198
Oxford	9 37·0	155	10 4·0	198
Liverpool ...	9 36·5	160	9 56·5	192

Which are Greenwich mean times: the angles are reckoned as is usual in the occultation-predictions of the *Nautical Almanac*, for the inverted image. At Greenwich